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ABSTRACT

The design of the CAI interface described is based on the microprocessor in order to meet three basic requirements for providing appropriate instruction to the developmentally handicapped: (1) portability, so that CAI can be taken into the customary learning environment: (2) reliability: and (3) flexibility, to permit use of new input and output devices as they are required and become available. The precise configuration of the terminal is determined by its use, and a number of special features are available, e.g., double size characters for use by the partially sighted, special graphic characters, animation, color, synthetic speech, and control of a random access slide projector. Input devices that may be used include a number pad, light pen, and touch sensitive display. Special devices for students with physical handicaps include the POSSUM apparatus, which may be controlled by a variety of binary switching devices, and the POSSUM Expanded Keyboard, both of which have been used by cerebral palsied students. Other special keyboards are designed to simplify the coding required for response, e.g., the "money" keyboard for social arithmetic problems. The terminal has also been developed into a stand-alone computer for use in areas without access to a host computer. (CHC)

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A MULTI-MEDIA CAI TERMINAL BASED UPON A MICROPROCESSOR WITH APPLICATIONS FOR THE HANDICAPPED

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The Need for a Multi-Media Terminal

The Computer Applications Unit in The University of Calgary Faculty of Education has been engaged in research and development relating to computer assisted instruction and computer managed instruction since 1969. Programs have been developed and used for a wide variety of subject areas and levels, from first grade arithmetic and language to university statistics. For some applications a hard-copy or CRT terminal has been very effective. For other applications a variety of input and output devices have been desirable, and sometimes essential.

The need for such specialized devices has been particularly obvious in the case of a CAI project with the developmentally handicapped (Hallworth & Brebner, 1979). Some developmentally handicapped students make good progress using a Teletype or a CRT terminal. However, some with physical handicaps, especially the cerebral palsied, are unable to use a standard keyboard. Partially sighted students are unable to see normal size characters produced by a hard-copy or a CRT terminal.

Moreover, it has long been accepted that developmentally handicapped students should have programs relating specifically to their own interests and needs, and aimed at the development of "social survival skills" (Clarke & Clarke, 1965). Arithmetic, for example, should be "social arithmetic" centered around money handling and shopping, with the courseware incorporating images of coins, bills, and articles to be purchased. Programs to teach prereading, reading, and social sight vocabulary obviously require both image projection and audio output.

The CAI project at the Calgary Vocational and Rehabilitation Research Institute was started in 1971 and has shown that, in order to provide

instruction appropriate for the developmentally handicapped, a "CAI station" is needed which incorporates a variety of input and output devices. Experience with CAI in other environments has also indicated that such a station is advantageous to many learners. This is the case, for example, with first grade students learning counting and reading (Moont, 1978), and with university students taking nursing courses.

CAI Station Interfaces

The Computer Applications Unit has always used a dedicated general purpose time-shared computer for its research and development work. However, since the software supplied with such machines has traditionally been designed to service only a standard terminal at each port, the use of a CAI station has necessitated an interface between the computer and the station.

The first such interfaces were designed by the Unit in 1969 to allow operation of both a terminal and a slide projector, and remained in use until 1979. An interface developed by the National Research Council was also used, which incorporated a CRT terminal, a slide projector, a tape recorder, and an ultra-sonic touch sensitive display (Hlady, 1969). A later commercial version of this design included a cassette recorder and a touch sensitive display with light emitting diodes.

However, although each was a significant advance, none of these interfaces provided an adequate solution to all problems. A satisfactory interface must be portable, in order to take CAI to the learner in his customary learning environment; it must be reliable, in order to promote credibility in the system; and it must be flexible, in order to take advantage of new input and output devices as they are required and become

available.

Consequently, it was decided to design an interface based on a microprocessor. Fifteen such devices have now been built and have been in use for eighteen months.

A Microprocessor-Based Terminal

In order to obtain a reliable interface it was decided to use a microprocessor which had a proven record and for which there was ample software available. For this reason, the 8080 chip was selected. In order to ensure flexibility, it was necessary to have a standard bus for which a large number of manufacturers were already providing equipment, therefore the S-100 bus was used. Since the terminal was designed to be modular, with no large components, it could be easily transported.

The precise configuration of a terminal is determined by its use. The S-100 bus has space for up to 21 boards. Besides the CPU board the terminal may have, as memory, from 4K to 56K bytes of RAM and from 4K to 16K bytes of EPROM. A character generator board provides for 24 lines of 80 standard size characters, or 12 lines of 40 double size characters for use by the partially sighted; it also provides simple graphic characters. A graphics board gives control of 240 x 256 individual points on the CRT monitor, and could be used for special character sets, animation and, with the addition of two further boards, colour. A synthetic speech board is also in use, with digitized words stored either in EPROMs or on a floppy disk. Boards have been designed and constructed to control a random access slide projector, and to make a front panel unnecessary so that a terminal is activated simply by switching on the power. A multi-channel

input-output board and an interrupt board are used and boards to control floppy disks are introduced when required.

The remaining equipment for the terminal includes a 17" CRT monitor, a random access slide projector, a rear view screen, and a speaker.

The software for the terminal consists of utility programs developed in 8080 code in order to facilitate the use of the boards referred to above. One such program services a light pen.

CAI programs are written for the host computer in DEC BASIC-PLUS, employing user defined functions for input and output and for control of the various station devices. For example, the function parameters to show a slide are "SLI" and the slide number; to output a message via the speech synthesizer they are "SAY" and the message number.

Each BASIC-PLUS program has attached to it a sub-routine which acts as a link to the utility programs.

The terminal keyboard has an EIA connection. This will accept a number pad, a light pen, or any of the special input devices presently in use or under development.

Applications With The Handicapped

The microprocessor-based terminal has proved invaluable for the CAI project with developmentally handicapped students. Not only has it been very reliable in operation but also its flexibility allows the courseware programmer to use a wide range of input and output devices.

In the case of the social arithmetic programs, for example, the standard form of output is by large size characters on a 17" CRT terminal. For partially sighted students, it was previously necessary to display

standard size characters on a 23" video monitor. Slides of coins, bills, and articles to be purchased, can be used reliably with the terminal operating over a wide range of baud rates, whereas previous interfaces were restricted to 110 or 300 baud.

Special character sets may be designed and used on the CRT monitor. A possible future requirement for CAI with the handicapped, for example, is to display Bliss symbols.

Synthetic speech is already used to a limited degree, and can be expanded by the addition to the terminal of a floppy disk or other mass storage device. Although too many instructions confuse the handicapped (Brown & Hughson, 1972), a small amount of audio output has been demonstrated to enhance their learning (Holz, 1976).

As indicated earlier, some of the input devices presently in use are designed to overcome students' physical handicaps. These include, for example, the POSSUM apparatus. This consists of a transparent indicator board divided into a matrix having nine rows and columns, with a character in each cell. A light behind the board is moved first in a horizontal and then in a vertical plane, and is controlled by any binary switching device such as a joystick, a dual rod control, a footswitch, a handswitch, a headswitch, or a pneumatic mouthpiece on which the user sucks or puffs. Another special input device is the POSSUM Expanded Keyboard, a rugged box on which the student can lean whilst finding large and well spaced recessed keys. Cerebral palsied students have been able to make use of both pieces of equipment.

Other input devices are aimed less at overcoming physical handicaps than at facilitating learning by eliminating some of the superfluous mental

processes otherwise required of the learner using the standard keyboard. In effect, a light pen and a touch sensitive display operate in this way: the learner answers a question merely by selecting it on the screen. Without such a device it would be necessary to code the answer either numerically or alphabetically and then enter the code via the standard keyboard.

However, a special keyboard may be designed to simplify the coding required. For example, a "money keyboard" has been developed for use with the social arithmetic programs. The keys are actual bills and coins. To enter an amount of money, the student merely touches the necessary "money" keys. For a program to teach the meaning of laundry symbols, a special keyboard is used with the actual symbols on the keys. A program to teach a sense of time uses keys which represent "Early", "On Time" and "Late". Basic nutrition is taught by a program which uses a keyboard with four keys representing the four food groups; and a program to train cafeteria cashiers uses an actual cash register as a keyboard by replacing the original keys by pieces of bubble-pad keyboard.

Obviously, the use of "concept" keys on a special keyboard, as described above, may be extended much further, and not only for use with the handicapped. The procedure has already been used successfully to teach statistics to university students (Taerum, 1979).

Present Developments

The microprocessor-based terminal has made CAI an effective and economic tool for teachers of developmentally handicapped students who are close to the host computer. Communications costs to rural areas, however,

are prohibitive. The terminal has therefore been developed into a stand-alone computer by the addition of more RAM and dual floppy disks. This system has operated successfully for a period of nine months in a small town 80 miles from Calgary.

As the incorporation into the terminal of a videodisc system presents few technical problems, a project has been initiated to make appropriate developments to the existing courseware.

Mass storage used as a shared resource will hopefully reduce the cost of program distribution and record keeping. It will then be economically feasible to establish a multi-terminal system to supply CAI in any centre for the handicapped, whether urban or rural.

References

Brown, R. I. and Hughson, E. A. Verbal instruction in the performance of non-verbal tasks. Report to the Alberta Human Resources Research Council, 1972.

Clarke, A. M. & Clarke, E. D. B. Mental Deficiency: The Changing Outlook. London: Methuen, 1965.

Hallworth, H. J. and Brebner, Ann. Development of computer assisted instruction at the VRRI. In R. I. Brown & M. B. Bayer (Eds.), Research, Demonstration, Practice: Ten Years of Progress. Calgary, Alberta: Vocational and Rehabilitation Research Institute, 1979.

Hlady, A. M. A touch sensitive X-Y position encoder for computer input. Proceeding of the Joint Fall Computer Conference, American Federation of Information Processing Societies, 1969.

Holz, Else. A study of the use of computer assisted instruction for teaching a social sight vocabulary to mentally handicapped adolescents. Unpublished M.Sc. thesis, University of Calgary, 1976.

Moont, Susan E. A study of the use of computer assisted instruction for teaching a counting skill and a vocabulary skill at the Grade One level. Unpublished M.Sc. thesis, University of Calgary, 1978.

Taerum, T. V. A teaching procedure for computer assisted instruction in mathematics and statistics. Unpublished doctoral thesis, University of Calgary, 1979.